VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

R. H. LEASBURG
VICE PRESIDENT
NUCLEAR OPERATIONS

June 30, 1982

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
Attn: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Serial No. 375
PSE&C/brc/WCS/KSB

Docket Nos. 50-280
50-281
License Nos. DPR-32
DPR-37

Gentlemen:

GENERAL DESIGN CRITERIA 17 ANALYSIS
SURRY UNIT NOS. 1 AND 2

The purpose of this letter is to transmit items which we have previously committed, in our June 11, 1982 submittal, serial no. 175, to supply to you by June 30, 1982.

Attachment I consists of operating procedures for Surry and the Vepco System Operator which have been implemented. These integrated procedures have been developed to maintain the transmission system voltage within the GDC 17 limitations. Additionally, the station procedures incorporate restrictions developed as a result of our GDC 17 analysis.

Attachment II is a draft of our proposed Technical Specifications which address the addition of degraded voltage protection and upgrading of loss of voltage protection.

Attachment III consists of voltage profile results for electrical arrangements analyzed at your request. The two arrangements analyzed are a single 500/230/36.5KV autotransformer supplying both 34.5KV reserve system buses and the 230/36.5KV transformer supplying both 34.5KV buses. Our analysis indicates these arrangements do not fully comply with GDC 17 criteria for the scenarios analyzed. The maximum duration of operation in one of these arrangements is limited to seven days, per Technical Specifications. In view of the occurrence probability of the scenarios analyzed, the seven day limitation provides sufficient restriction for these arrangements. Modifications are not required to prevent these operating arrangements.

A001

In review of our schedule submitted in our March 31, 1982 letter, Serial No. 175, we believe we should revise our targeted completion dates to provide for the possibility of an unanticipated response from the valve manufacturer regarding motor operated valves at Surry and an unanticipated result from the MCC control transformer studies. Also, the 4KV cable replacement requires a dual unit outage which will not occur until the second refueling after September 1, 1982. A more realistic construction schedule in view of currently scheduled projects will be to complete all modifications by the second refueling outage of each unit after September 1, 1982.

Very truly yours,

R. H. Leasburg

Attachments

cc: Mr. R. C. DeYoung, Director
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Washington D.C. 20555

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DOCKET NO. 50-280...VEPCO...SURRY

SYSTEM OPERATORS' PROCEDURES MANUAL

Rec'd w/ltr 6/30/82...8207080213

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A. GENERAL

1. Maintaining voltages within safe operating limits is essential to reliable transmission system operation. This guide outlines basic considerations for the System Operator to follow in maintaining these voltage levels. The System Operators' authorities, responsibilities and required actions are also defined. Experience has shown that successful voltage control is dependent upon anticipating voltage trends and initiating corrective action before critical periods of heavy or light load are reached. The System Operator should therefore be aware of the importance of voltage control and the necessity to take action as soon as a potential problem is recognized.

2. System voltage levels are dependent on meeting the VAR requirements of the system. When a system is heavily loaded, lagging VARS are required from the system by the load. The source of these lagging VARS are generating units operating in the lag (overexcited) condition, putting VARS out of the units into the system. Additional sources of lagging VARS are static capacitor banks, and transmission line capacitance. During light load conditions a system may experience an excessive amount of leading VARS. These VARS are coming from the system and must be absorbed by generating units operating in the lead (underexcited) condition, reactor banks, or synchronous condensers operating in the lead (underexcited) condition.

3. The reactive generating capability of transmission line capacitance is directly proportional to the square of the applied voltage. The reactive capability of the Mt. Storm-Morrisville line for example, varies from 218.5 MVARs at 525 KV to 178.9 MVARs at 475 KV. As the load on a line increases, its reactive losses also increase. When the reactive losses equal the reactive generating capability, the surge impedance loading (SIL) of the line is reached. Loading beyond this point creates a VAR deficiency which must be supplied by capacitor banks or generating units operating in the lag condition.

4. High voltage conditions increase a transmission line's reactive generating capability. The increased reactive tends to increase the voltage level in an amplifying manner. High voltage problems generally occur when the EHV system is lightly loaded and therefore has excessive leading vars. Corrective action for this condition would be an attempt to increase reactive losses of the network or decrease the reactive sources.

A. 5. Although this guide primarily addresses the 500 KV system, the 230 KV system must also be monitored. It is doubtful that sustained voltage excursions will be present on the 230 KV system and not on the 500 KV system. However certain local conditions could cause such a situation. If the 230 KV system is outside its alarm points (219 KV to 246 KV) appropriate steps should be taken to return the voltage to the proper level. The high level alarm for Surry Power Station is set at 240 KV.

B. NORMAL CONDITIONS

1. Primary system voltage control should be accomplished using only controllable reactive sources including generating units, hydro units operating as synchronous condensers, bus capacitors and bus reactors.

2. Secondary system voltage control can be used to balance or trim system voltages only after primary control has been fully utilized. Secondary control should be accomplished using transformer LTC tap changers.

C. LOW VOLTAGE CONDITIONS

1. The System Operator should recognize the potential for, or development of, a low voltage condition and take steps to prevent equipment damage and/or an uncontrolled area shutdown. If bus voltages are low and allowed to continue decaying, the VAR output of the system capacitor banks and transmission lines is reduced. The resulting VAR deficiency must be supplied by generating units operating in the lag condition, often at the expense of MW output. This process, if allowed to continue would eventually reach the point where generating units would reach their VAR output limits, the output of other VAR sources would continue to decrease, and the voltage would continue a steady decline.

   a. Slow voltage Decay Procedure (Apparent load build up towards peak and lack of generation support.)

      (1.) The low voltage alarm points for the data acquisition computer are set at 510 KV at the North Anna and Surry busses, and at 475 KV throughout the rest of the 500 KV system. The critical voltage at North Anna and Surry is 505 KV. Refer to Section E. for specific instructions involving

C. 1. a. (1.) (con't) nuclear stations. When an initial alarm is generated, immediate action should be taken to reverse the trend and restore the voltage to normal, or scheduled, levels. The data acquisition computer is programmed to alarm at the set point and initiate a "low limit exceeded" message. Action must be taken at this point to reverse the trend. If the voltage decay continues beyond this limit and exceeds one percent of the alarm setting a second message will be generated indicating an "exceeded one percent significance alarm level" message. If the second alarm level is reached all actions within the authority of the System Operator (as outlined in this procedure) must be executed as expeditiously as possible. When the first alarm level is reached proceed with each of the following steps until the voltage is established above the alarm setting. System conditions may alter the actual order of these steps.

(2.) Check that the reactor banks at Surry, North Anna, and Carson are out of service. If not, arrange to have them de-energized as quickly as possible. The Carson bank may be operated by supervisory control from the System Operation Center. Plant personnel must be contacted at North Anna and Surry to operate those banks.

(3.) Check that all transmission voltage capacitor banks are in service. If not arrange to have them switched on as quickly as possible.

(4.) Contact all power stations to insure each unit on line is operating in the maximum permissible lag condition. If stations cannot maintain their voltage schedules, request an explanation and make note of it in the System Operators' Log.

(5.) Raise generation levels on units in the low voltage area (or in an area which could provide some improvement in the voltage level) to reduce power transfers and hence the I^2X losses.

(6.) Request interconnected companies to take all steps possible to help maintain system voltage schedules. Suggested steps include 1) increasing voltage levels on the interconnected system, 2) making additional transactions with Vepco that may improve system voltages, or 3) changing transaction schedules with other systems that may be contributing to the Vepco problem.

C. 1. a. (7.) Start additional units in the low voltage area to supply reactive and reduce power transfers.

(8.) If steps C.1.a.(1.) through C.1.a.(7.) fail to improve the voltage situation notify the System Operation Duty Supervisor or the Chief System Operator.

Note: If system voltages continue to decline the next step will be implementation of the Company's Load Curtailment Program (Section 17.05 Vepco Policy and Procedures Manual). The Manager-Power Supply will decide when and to what extent load curtailment is required. He will select the plan or combination of plans necessary to achieve the required curtailment and will notify the appropriate regulatory agencies of the load curtailment action taken.

b. Rapid Voltage Decay Procedure (Sudden loss of large blocks of generation).

(1.) In cases of extreme emergency, where load must be shed quickly, the Senior System Operator will determine the need for immediate implementation of Plan III - Phase A of the Load Curtailment Program and will shed load directly from the System Operation Center through the division SCADA systems. Either one or both of two 600 MW increments may be shed.

(2.) Immediately following an emergency SCADA implemented load curtailment from the System Operation Center, the Senior System Operator will advise the Division Operation Centers and the Chief System Operator of the action taken. The Chief System Operator will notify the Manager-Power Supply who will then notify the Manager-Division Services and the Manager-Communications.

(3.) In emergency situations where there is time to notify the divisions, the Senior System Operator will determine the need for implementation of Plan III - Phase A and will issue orders to execute the plan directly to the appropriate Division Operating Managers, or their designated representatives, specifying the number of load increments to be shed.

(4.) As the SCADA systems continue to be expanded, there will be a continuing increase in the number of SCADA controlled circuits available for rotational interruptions. SCADA controlled circuits should be used along with manually controlled circuits with the provision that at least four (4) increments of load are available for quick curtailment by other SCADA controlled circuits.

C. 1. b. (5.) The Chief System Operator will advise the Manager-Power Supply of the action taken and he will then notify the Manager-Division Services and Manager-Communications.

(6.) When manual load shedding instructions are executed, each District Manager will immediately issue the appropriate press release.

(7.) When the need for load curtailment is past, the System Operator will issue service restoration instructions directly to the appropriate Division Operating Managers, or their designated representatives. Loads will be restored only in the amounts and at the times specified by the System Operator.

(8.) The Chief System Operator will advise the Manager-Power Supply of the action taken and he will then notify the Manager-Division Services and Manager-Communications.

D. HIGH VOLTAGE CONDITIONS

1. During light load conditions, unacceptably high voltages may exist on the EHV system. If bus voltages are high, the VAR output of system capacitor banks (if left in service) and transmission line capacitance is increased. The resulting VAR surplus must be absorbed by generating units or synchronous condensers operating in the lead condition. If left unchecked this condition could result in generating units reaching their VAR intake capabilities, loss of major VAR absorbing units and a further compounding of the problem. High voltage conditions may be particularly prevalent if several major units are out of service during light load periods or if the generating units are not operating at their maximum lead condition.

   a. The high voltage alarm points for the data acquisition computer are set at 530 KV at the North Anna and Surry busses, and at 535 KV throughout the rest of the 500 KV system. The critical voltage at North Anna and Surry is 535 KV. Refer to Section E. for specific instructions involving nuclear stations. When an initial alarm is generated immediate action should be taken to reverse the trend and restore the voltage to normal, or scheduled levels. The data acquisition computer is programmed to alarm at the set point and initiate a "high limit exceeded" message. Action must be taken at this point to reverse the trend. If the voltage rise continues beyond this limit and exceeds one percent of the alarm setting a second message will be generated indicating an "exceeded one percent significance alarm level" message. If the second alarm level is reached all actions within the authority of the System Operator (as outlined in this procedure) must be executed

D. 1. a. (cont't) as expeditiously as possible. When the first alarm level is reached proceed with each of the following steps until the voltage is established below the alarm setting. System conditions may alter the actual order of these steps.

b. Check that all transmission voltage capacitor banks are out of service. If not, arrange to have them switched out as quickly as possible.

c. Check that the reactor banks at Surry, North Anna, and Carson are in service. If not, arrange to have them switched on as quickly as possible. The Carson bank may be operated by supervisory control from the System Operation Center. Plant personnel must be contacted at North Anna and Surry to operate those banks.

Note: Under certain operating conditions at Surry the reactor banks may cause an overload on one of the transformers feeding the 34.5 KV bus. This condition is alarmed in the System Operation Center. If this alarm is received, the plant should be notified immediately so that the overload condition can be corrected.

d. Contact all power stations to insure each unit on line is operating in the maximum permissible lead condition. If stations cannot maintain their voltage schedules request an explanation and make note of it in the System Operator's Log.

e. Check with the interconnected companies to make certain they are operating in maximum lead condition and are on voltage schedule.

f. Instruct Roanoke Rapids operators to operate Roanoke Rapids and Gaston units (where possible) as synchronous condensers in the maximum lead condition.

g. Have a switchman sent to Mt. Storm switchyard. Open the Mt. Storm end of line no. 572. As soon as possible after the Mt. Storm end is opened, open the Morrisville end of line no. 572 by supervisory control from the System Operation Center. Arrange to have breaker disconnects opened as soon as possible after the breakers are opened.

h. If the voltage continues to rise or does not drop below the alarm point, open the Surry-Carson line no. 562 at the Surry end followed as quickly as possible at the Carson end. Arrange to have breaker disconnects opened as soon as possible after the breakers are opened.

D. 1. i. If the voltage continues to rise or does not drop below the alarm point, open the Ladysmith-Ox line no. 552 at the Ladysmith end followed as quickly as possible at the Ox end. Arrange to have breaker disconnects opened as soon as possible after the breakers open.

j. If steps D.1.a. through D.1.i. fail to improve the voltage situation notify the System Operation Duty Supervisor or Chief System Operator.

Note: Further attempts to reduce system voltages may involve reduction of generation and/or removal of certain units from service. The Manager-Power Supply will determine when and to what extent additional action is required.

E. SPECIFIC INSTRUCTION - NUCLEAR POWER STATIONS

1. Due to voltage restrictions at the nuclear power stations the Station Operators at Surry and North Anna will be following a station voltage control procedure prior to reaching the System alarm points.

   a. When the voltage schedule cannot be met because of Station limitations, the Station Operator will contact the System Operator. Record the deviation and limiting factor in the System Operators' Log.

   b. When all measures defined in the station voltage control procedure have been utilized and the station voltage cannot be maintained between 512 KV and 528 KV (222KV and 238KV on the Surry 230KV bus) the Station Operator will contact the System Operator. Record in the System Operators' Log and if the System alarm limits (510 KV or 530 KV) are reached begin implementation of the appropriate procedure to assist in the correction of the condition. All measures must be taken to avoid the limits of 505 KV or 535 KV at the nuclear stations.

   c. When the voltage regulator is being operated in the manual mode, the Station Operator will contact the System Operator. Record this condition and the reason for it in the System Operators' Log.

   d. Before reactor banks are removed from or placed in service, the Station Operator will contact the System Operator. Record all reactor bank switching in the System Operators' Log.

E. 1. e. When the voltage regulator is being operated in the automatic mode and adhering to the voltage schedule requires operating a unit beyond its safe operating limit curve, the Station Operator will notify the System Operator. Station personnel will decide whether to go beyond this limit based on current station equipment status. Record in the System Operator's Log the fact that the limit has been reached, whether the station has decided to go beyond this limit, and if so, the steady state limits reached after the adjustment has been made.

f. When the voltage regulator is being operated in the manual mode and adhering to the voltage schedule requires operating beyond its safe operating limit curve, the Station Operator will contact the System Operator. Operation beyond this limit in the manual mode can only be authorized by the System Operator. Record the fact that the limit has been reached in the System Operators' Log. Current instructions are not to operate a unit beyond its safe operating limit while the voltage regulator is in the manual mode.

Caution: When operating a unit in the lead condition (ie. taking MVARs in), the MVAR limit shall be governed by the "safe operating limit" on the generator capability curve. This is a conservative limit for underexcited operation. Below this limit, there is the MEL (minimum excitation limiter) characteristic and the KLF (loss of field relay) characteristic. The MEL is a protective feature internal to the voltage regulator which will limit exciter field current to a pre-determined level only when the regulator is operated in automatic. If the regulator is operated in manual the MEL unit is not functional and operation below the "safe operating limit" could result in a KLF operation and unit trip without prior alarm.

230 KV SWITCHYARD VOLTAGE

References:

1. Surry Units 1 & 2 GDC 17 Analysis, Letter dated 3-31-82, S. N. 175 to H. R. Denton from R. H. Leasburg

2. Generator Capability Curves (Page 44 of Unit 1 Curve Book)

3. Unit 1 Control Room Operators Instrument Surveillance Log, 1-PT-36, page 1 of 12.

4. Surry 230 KV Bus Voltage Schedule

5. Op-43.0, Generator Hydrogen System

6. FE 21A, 21F

1.0 Purpose

This procedure provides recommendations for corrective action to be taken in the event the 230 KV Bus Voltage schedule cannot be met. By operating the unit 1 generator such as to maintain the 230 KV Bus voltage on schedule, it will be easier to maintain the 500 KV Bus voltage within the limits assumed in the Surry GDC-17 Analysis (505 KV - 535 KV). By maintaining the 500 KV Bus voltage above 505 KV following a one or two unit trip, it has been demonstrated by analysis that the voltage on the station buses will be such to ensure the starting of all safety related equipment required under worst case conditions without transferring loads to the emergency diesels. By maintaining the voltage below 535 KV, it has been demonstrated by analysis that the voltage on the station buses will typically be such as not to exceed equipment ratings and hence not result in reduced equipment life.

2.0 Initial Conditions

2.1 The main generator is in service.

2.2 The generator voltage regulator is operating in automatic. If the regulator is operating in manual, extra operator attention may be required to maintain voltage schedule.

2.3 The control room operators are monitoring 230 KV Bus voltage in accordance with Attachment II. If the voltage is exhibiting instability or other evolutions are in progress which require the attention of the control room operator(s), enter computer alarm points at plus and minus 2 KV of the scheduled voltage. These alarm points will have to be updated each hour that the voltage schedule changes until the operators can resume their normal surveillance.

2.4 The actual 230 KV Bus voltage deviates by more than 2 KV from the scheduled voltage as noted on the Control Rm Operator's Instrument Surveillance Log, 1-PT-36.

3.0 Precautions and Limitations

3.1 Maintain H_2 pressure between 55 PSIG and 60 PSIG. Be prepared to increase generator pressure in order to attain full MVAR capability. This is especially important when operating the generator in the overexcited mode since at 55 PSIG, MVARs out are limited to 400 MVAR. Gas pressure must be increased to 60 PSIG before increasing MVARs out to ultimate limit of 430 MVAR.
NOTE: MVAR limitations specified in this procedure are for operation at 100% power. At lower power levels, the limits are higher (Reference Attachment I).

3.2 Monitor the generator core monitor closely during periods when the generator is being operated at high MVA loadings.

3.3 Limit generator amps to 24,713 at rated voltage of 22 KV.

3.4 The Summer continuous 90°C ratings for the 4 KV Cable between the Reserve Station Service Transformers and the Transfer Buses are as follows: 1684 Amperes for the cable on the secondary side of RSSTs A and C, 1624 Amperes for the cable on the secondary side of RSST B. During startup of one unit or within 1 hour of a one unit trip RSST loadings must be reduced below these ratings. With one unit in startup and one unit tripping or with two units tripping, RSST loadings must be reduced to 3000 Amperes within 30 minutes and to the specific cable ratings within 60 minutes.

3.5 Generator output voltage shall be maintained between 20.9 KV and 23.1 KV.

3.6 The unit 1 Station Service Buses 1B and 1C shall be operated between 4.0 KV and 4.4 KV. The 4.0 KV limit is based on limiting the stator temperature of the High Pressure Heater Drain Pump motors and most likely will be the limiting factor when operating a unit in the underexcited (MVARs in) mode. Station Service Bus 1A should normally be operated between 4.0 KV and 4.4 KV until operation between 3.6 KV and 4.0 KV has been demonstrated to be acceptable by further testing.

3.7 When operating the generator at a leading power factor (i.e. taking MVARs in), the MVAR limit shall be governed by the "Safe Operating Limit" on the generator capability curve unless directed otherwise by the System Operator. The Safe Operating Limit is a conservative limit for underexcited operation. Below this limit, there is the MEL (minimum excitation limiter) characteristic and the KLF (loss of field relay) characteristic. The MEL is a protective feature internal to the voltage regulator which will limit exciter field current to a predetermined level only when the regulator is operated in automatic. If the regulator is operated in manual (Base Adjuster control), the MEL unit is not functional, and operation below the Safe Operating Limit could result in a KLF operation and unit trip without prior alarm. The control room operator has no means to know from the control room that the MEL unit has operated other than the fact that the regulator is notresponding to demand for lowering voltage. Operation of the MEL unit can be verified locally at the regulator panel. The KLF relay protects the unit against a loss of stability by tripping the exciter field breaker and the generator output breakers. The curves for MEL and KLF plotted on Attachment I are for a generator voltage of 22 KV. As the voltage varies from 22 KV, the curves shift upward for voltages less than 22 KV and downward for voltages greater than 22 KV.

3.8 When operating the generator at a lagging power factor (i.e. putting MVARs out), the MVAR limit shall be governed by the generator capability curve. It will be necessary to increase generator hydrogen pressure to 60 PSIG in order to reach the limit of 430 MVARs out.

3.9 Although not shown on the generator capability curves, the regulator has internal to it certain alarm and protective circuits which protect the generator when operating in the overexcited mode. These circuits do not perform their functions until the generator is operating outside the 60 PSIG capability curve, and therefore, their characteristics are not overlayed on Attachment I. These circuits operate as follows:

3.9.1. Forcing alarm picks up via K4 relay. Forcing alarm senses the DC current from the regulator power amplifiers to the exciter through an isolation transducer. This is only an alarm (Ann. window J-7, "Excitation Field Forcing") and has no tripping function.

3.9.2 The OXP-2 circuit senses the same signal as the forcing alarm. It operates in the following manner:

3.9.2.1 K1 picks up on an initial overexcitation and starts an inverse time delay dependent on the level of overexcitation. K1 also runs the base adjuster to a predetermined position by use of cam switches. <u>Note:</u> While K1 is timing, the regulator is still in auto control and voltage adjustments may be attempted by using Voltage Adjuster control switch. Since the base adjuster unit is automatically running to a preset position which upon reaching this position illuminates the white light above the Base Adjuster control switch, do not adjust the Base Adjuster control switch during this time.

3.9.2.2 After time delay for K1 has timed out, K2 picks up and trips the regulator from auto to base control and alarms Ann. window J-23, "Voltage Regulator Auto Trip". A contact from K2 also alarms Ann. window J-8, "Overexcitation".

3.9.2.3 After a fixed time delay in base control (approx. 3 sec.) if the overexcitation condition still exists, K3 picks up and trips the exciter field breaker (Mach. Trip).

3.9.2.4 If the unit did not trip, place the auto voltage regulator to OFF and adjust voltage with the Base Adjuster. Notify the System Operator that the voltage on the machine is being controlled manually.

3.10 The loss of regulator sensing voltage supplied by the voltage regulator potential transformers (possibly caused by a blown fuse) will automatically trip the regulator from auto to base control accompanied by the alarming of Ann. Window J-62, "Gen PT Blown Fuse" and Ann. window J-23, "Voltage Regulator Auto Trip".

3.11 The lights above the Base Adjuster control switch provide the following information:

Green light - Base Adjuster output is at lower limit.
Red light - Base Adjuster output is at upper limit.
Amber light - Base Adjuster output is at no load pre-position level. Any time the exciter field breaker is opened or the breaker is racked to the Disconnect or Test position, the Base Adjuster is run back to this predetermined position.
White light - Base Adjuster output is at full load pre-position level. When the K1 relay in the overexcitation protection circuit is energized, the Base Adjuster is run back to this predetermined position.

3.12 The lights above the Voltage Regulator control switch provide the following information:

Green light - Regulator output is at lower limit
Red light - Regulator output is at upper limit
Amber light - Regulator output at intermediate level as determined by adjustable cam switch setting.

3.13 The modes of operation of the voltage regulator are as follows:

3.13.1 OFF (Green light illuminated) - The only control of machine voltage is by the Base Adjuster control switch. There is no feedback of actual voltage via the regulator to the Trinistat Firing Circuit and the MEL unit is not operational. Before closing into the system, variations in turbine speed will change generator voltage.

3.13.2 TEST (Amber light illuminated) - The Base Adjuster control switch is the only means to control generator voltage. The output of the regulator logic drawer is not connected to the Trinistat Firing Circuit. The Voltage Adjuster control switch can be used to balance the regulator output meter since its operation will not change generator voltage.

3.13.3 ON (Red light illuminated) - The Voltage Adjuster control switch is used to adjust the desired setpoint for generator voltage. The feedback intelligence circuit will compare actual voltage with desired voltage and generate the appropriate buck or boost signal to the Trinistat Firing Circuit to vary exciter field current. The Base Adjuster control switch can be used to balance the regulator output meter since its operation will not change generator voltage.

3.14 The voltage regulator "balance volts" should be maintained at 0 using the appropriate control switch. When operating with the voltage regulator control switch in "ON", balancing should be done by using the Base Adjuster control switch. With the voltage regulator switch in "OFF", the switch must be placed in "TEST" before balancing using the Voltage Adjuster control switch. These operations will not cause generator voltage to change. They ensure that the voltage regulator output signal will not be overranged and will permit full regulator action under transient conditions.

3.15 There exists the possibility that the tertiary of the 500/230/36.5 KV autotransformers (rated for 97.7 MVA at a 55°C winding temperature rise) could become overloaded when the reactor banks on the 34.5 KV buses are in service. At 85 MVA loading, the System Operator will receive an alarm and will notify the Shift Supervisor of the condition. The station should remove one reactor bank at a time from service until the alarm clears. This action shall be taken within 30 minutes of the time the System Operator contacts the station.

3.16 There exists the possibility that the 230/36.5 KV transformer (rated for 112 MVA) could become overloaded when it is feeding a 34.5 KV Bus with reactor banks in service. At 95 MVA loading, the System Operator will receive an alarm and will notify the Shift Supervisor of the condition. The station should remove one reactor bank at a time from service until the alarm clears. This action shall be taken within 30 minutes of the time the System Operator contacts the station.

Initials

4.0 Procedure

4.1 Corrective actions to be taken in the event 230 KV voltage is sagging below scheduled voltage (Attachment II).

_______ 4.1.1 Initial conditions are noted and satisfied.

_______ 4.1.2 Precautions and Limitations are noted.

_______ 4.1.3 Verify generator core monitor is energized.

NOTE: The following steps assume the regulator is in automatic. If the regulator is operating in manual, the Base Adjuster control switch must be used to raise generator voltage.

_______ 4.1.4 Use Voltage Adjuster control switch in the raise direction to attempt to increase 230 KV voltage to scheduled value. This will tend to increase the outward flow of VARS from the generator.

CAUTION: Reference Attachment I and Precaution and Limitation 3.1.

_______ 4.1.5 If the 230 KV Bus voltage falls more than 3 KV below scheduled, start taking hourly readings of the 230 KV Bus voltage and record data on Attachment III. Continue to adjust the Voltage Adjuster control switch in the raise direction as required in an attempt to meet the scheduled voltage.

_______ 4.1.6 If the 230 KV Bus voltage falls to 226 KV, verify that the 34.5 KV reactor banks are out of service. If they are in service, notify the System Operator before removing them from service.

_______ 4.1.7 Review Precautions and Limitations 3.5, 3.6, 3.8, and 3.9. At any time these limitations prevent increasing MVAR output of generator, notify the System Operator and document the reason on Attachment III.

_______ 4.1.8 If 230 KV Bus voltage falls to 224 KV, increase generator hydrogen pressure to 60 PSIG if not already done.

_______ 4.1.9 If the 230 KV Bus voltage falls to 222 KV, make sure the generator is being operated at the limit of 430 MVARs out unless other restrictions prohibit such operation.

NOTE: At 219 KV on the Surry 230 KV Bus, the System Operator will receive a computer data acquisition alarm. If at the same time the 500 KV Bus voltage is depressed, he will refer to Page 11.01(2) of the System Operators' Procedures Manual and initiate system level actions as specified in his procedure.

_______ 4.1.10 If voltage continues to drop below 222 KV and all actions above have been taken, immediately notify the System Operator.

_______ 4.1.11 Continue to log the information as started in Step 4.1.5 on Attachment III on an hourly basis until the 230 KV Bus voltage returns to scheduled voltage ±2 KV.

Completed By: ____________________

Date: ____________________

Initials

4.2 Corrective actions to be taken in the event 230 KV voltage is rising above scheduled voltage (Attachment II).

_______ 4.2.1 Initial conditions are noted and satisfied.

_______ 4.2.2 Precautions and Limitations are noted.

_______ 4.2.3 Verify generator core monitor is energized.

NOTE: The following steps assume the regulator is in automatic. If the regulator is operating in manual, the Base Adjuster control switch must be used to lower generator voltage.

_______ 4.2.4 Use Voltage Adjuster control switch in the lower direction to attempt to decrease 230 KV voltage to scheduled value. This will tend to increase the inward flow of MVARs from the system.

CAUTION: Reference Attachment I. Operation of the regulator in Base Adjuster control beyond the Safe Operating Limit requires prior System Operator approval (See Step 4.2.10).

_______ 4.2.5 If the 230 KV Bus voltage increases to more than 3 KV above scheduled, start taking hourly readings of 230 KV Bus voltage and record data on Attachment III. Continue to adjust the Voltage Adjuster control switch in the lower direction as required in an attempt to meet the scheduled voltage.

_______ 4.2.6 If the 230 KV Bus voltage increases to 234 KV, verify that the 34.5 KV reactor banks are in service. If they are out of service, notify the System Operator before placing them in service.

NOTE: Refer to Precaution and Limitation 3.15 and 3.16.

_______ 4.2.7 Review Precautions and Limitations 3.5, 3.6, and 3.7. At any time these limitations (especially the 4 KV limit on Station Service Buses) prevent increasing MVAR intake of the generator, notify the System Operator and document the reason on Attachment III. See Step 4.2.13 for further action.

_______ 4.2.8 If the 230 KV Bus voltage increases to 236 KV, increase generator hydrogen pressure up to 60 PSIG (Max.) as required. Note that higher pressures will not be required unless the generator is to be operated beyond the Safe Operating Limit (Reference Attachment I) or generator temperatures dictate the higher pressure.

_______ 4.2.9 If the 230 KV Bus voltage increases to 238 KV, make sure the generator is being operated at the Safe Operating Limit of 210 MVARs in provided the regulator is operating in automatic.

If generator output voltage drops sufficiently, the MEL unit may operate before reaching 210 MVAR in as explained in Precaution and Limitation 3.7.

NOTE: At 240 KV on the Surry 230 KV Bus, the System Operator will receive a computer data acquisition alarm. If at the same time the 500 KV Bus voltage is high, he will refer to Page 11.01(5) of the System Operators' Procedures Manual and initiate system level actions as specified in his procedure.

_______ 4.2.10 If the 230 KV Bus voltage increases above 238 KV, notify the System Operator that the generator is operating at the Safe Operating Limit of 210 MVARs in or is limited by the MEL unit as the case may be. If the regulator is operating in automatic and the MEL has not already limited MVARs in, the station will be authorized to operate beyond the Safe Operating Limit with concurrence of the Shift Supervisor. If the regulator is operating in manual (ie. Base Adjuster control), the System Operator will be responsible for authorizing operation beyond the Safe Operating Limit. Note authorized higher limit: ______________.

CAUTION: If regulator is being operated in manual, the MEL unit is not functional (Reference Precaution and Limitation 3.7).

_______ 4.2.11 When operating beyond the Safe Operating limit, increase the MVAR loading in 5 MVAR increments being careful to zero the "Regulator Balance Volts" meter after each increase using the Base Adjuster control switch. Use Voltage Adjuster if in manual regulator operation . If during this process of increasing the MVARs in, the MEL unit operates, the regulator will not respond to a demand signal for lowering voltage, and the generator will not take in any additional MVARs. Confirm that the MEL unit has operated by checking at the local regulator panel.

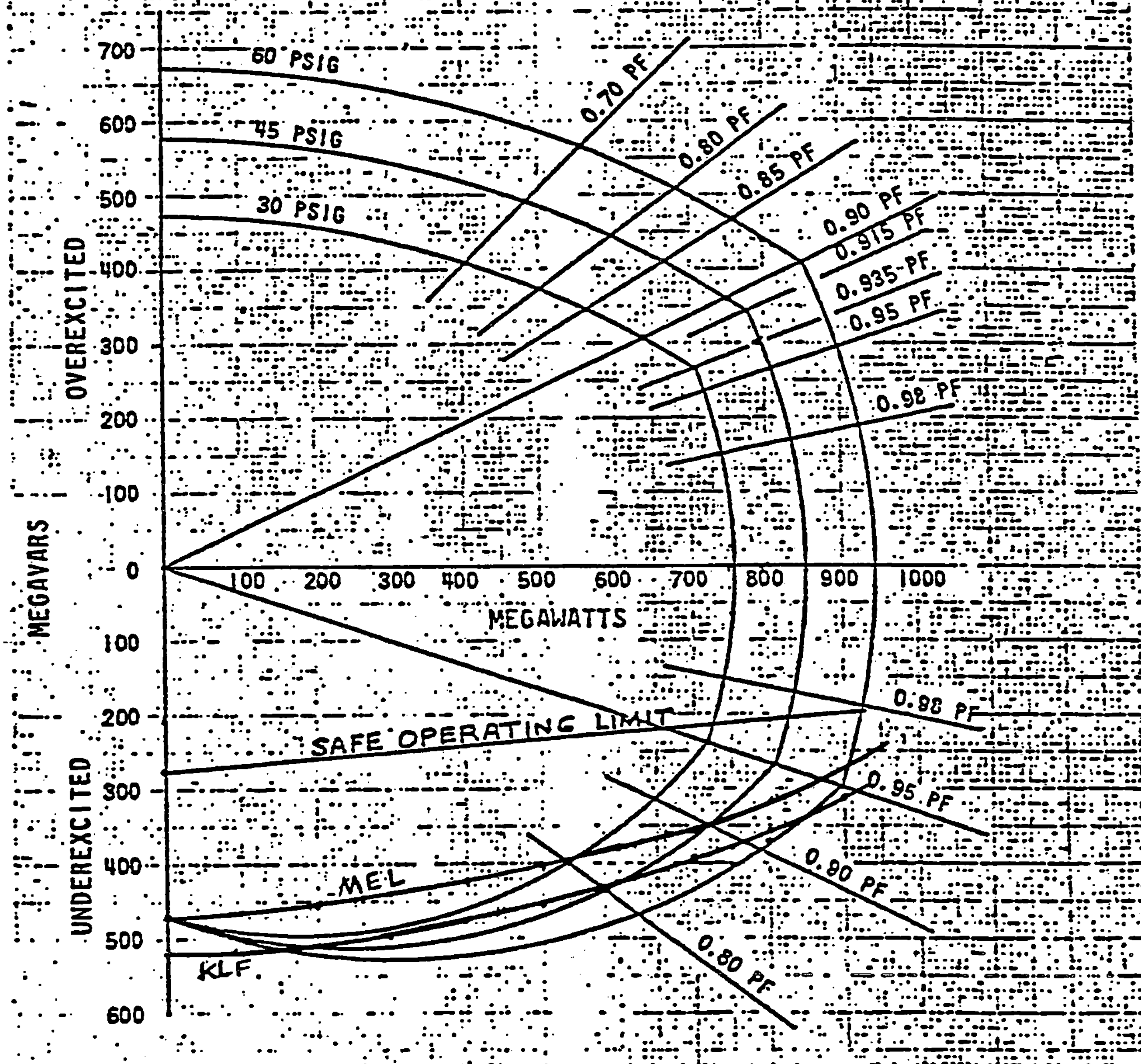
_______ 4.2.12 Notify the System Operator that the MVAR loading on the generator is limited by the regulator MEL unit. Record the MVAR limit on Attachment III.

_______ 4.2.13 Continue logging the information as started in Step 4.2.5 on Attachment III on an hourly basis until the 230 KV Bus voltage returns to scheduled voltage ±2 KV.

Completed By: ______________

Date: ______________

SURRY NO. 1



HYDROGEN INNER-COOLED TURBINE GENERATOR

CALCULATED CAPABILITY CURVES

941,700 KVA, 0.90 PF, 0.58 SCR, 60 PSIG, 3 PH

60 CYCLES, 1800 RPM

$I_{fl} = \frac{941,700}{(\sqrt{3})(22)} = 24,713$

APPROVED J. Wilson

[redacted]RMAN- SURRY POWER STATION [redacted]CLEAR SAFETY AND ~~OPERATING~~ COMMITTEE

DATE APR 1 0 1981

Curve 620411 Capability Curve FIG. 1

VIRGINIA ELECTRIC AND POWER COMPANY
VOLTAGE SCHEDULE

STATION Surry VOLTAGE 230 kV

Monday - Friday			Saturday - Sunday - Holiday		
Time	Schedule Voltage (KV)	On/Off Peak	Scheduled Voltage (KV)	On/Off Peak	Time
1:00 A	228	off	228	off	1:00 A
2:00 A	228	off	228	off	2:00 A
3:00 A	228	off	228	off	3:00 A
4:00 A	228	off	228	off	4:00 A
5:00 A	228	off	228	off	5:00 A
6:00 A	228	off	228	off	6:00 A
7:00 A	232	on	228	off	7:00 A
8:00 A	232	on	228	off	8:00 A
9:00 A	232	on	228	off	9:00 A
10:00 A	232	on	228	off	10:00 A
11:00 A	232	on	228	off	11:00 A
12:00 N	232	on	228	off	12:00 N
1:00 P	232	on	228	off	1:00 P
2:00 P	232	on	228	off	2:00 P
3:00 P	232	on	228	off	3:00 P
4:00 P	232	on	228	off	4:00 P
5:00 P	232	on	228	off	5:00 P
6:00 P	232	on	228	off	6:00 P
7:00 P	232	on	228	off	7:00 P
8:00 P	232	on	228	off	8:00 P
9:00 P	232	on	228	off	9:00 P
10:00 P	228	off	228	off	10:00 P
11:00 P	228	off	228	off	11:00 P
12:00 M	228	off	228	off	12:00 M

Authorized by: L.W. Ell. Manager-Power Supply Dept.
Date Effective: 6/7/82 Supersedes Schedule Dated 12-1-76

Notes:
1) All voltage changes should be made in the 10 minute period prior to the hour.
2) Only the following days will be considered as holidays: New Years Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day
3) In addition to days specified in (2) the system operator may designate holiday schedule for any other appropriate day.

SURRY
DEVIATION LOG
230 KV Voltage Schedule

Purpose: Record Data as required by 1-OP-26.5 whenever 230 KV Bus Voltage deviates by more than 3 KV from scheduled voltage.

UNIT	TIME	230KV		GEN		EXCITER		STATION SERVICE BUS(4K.V-4.4K.V)						REMARKS IF OTHER THAN STATION SERVICE VOLTAGE LIMITS	
		ACTUAL	SCHEDULE	VOLTS	VARS	VOLTS	AMPS	A VOLTS	AMPS	B VOLTS	AMPS	C VOLTS	AMPS		DATE

ADDITIONAL ADMINISTRATIVE LIMITS

NOTE: Until directed otherwise, at the end of each month, forward one copy of each completed Deviation Log to Director Power Supply Technical Services (4th Floor, OJRP). Questions related to the use of log should be directed to Phil Powell on Ext. 4343.

500 KV SWITCHYARD VOLTAGE

References:

1. Surry Units 1 & 2 GDC 17 Analysis, Letter dated 3-31-82, S. N. 175 to H. R. Denton from R. H. Leasburg

2. Generator Capability Curves (Page 44 of Unit 2 Curve Book)

3. Unit 1 Control Room Operators Instrument Surveillance Log 2-PT-36, page 1 of 12.

4. Surry 500 KV Bus Voltage Schedule

5. Op-43.0, Generator Hydrogen System

6. FE 21A, 21F

1.0 Purpose

This procedure provides recommendations for corrective action to be taken in the event the 500 KV Bus Voltage schedule cannot be met. By adhering as closely as possible to the scheduled voltage, the basis for the GDC-17 analysis (505 KV-535 KV) will not be violated. By maintaining the voltage above 505 KV following a one or two unit trip, it has been demonstrated by analysis that the voltage on the station buses will be such to ensure the starting of all safety related equipment required under worst case conditions without transferring loads to the emergency diesels. By maintaining the voltage below 535 KV, it has been demonstrated by analysis that the voltage on the station buses will typically be such as not to exceed equipment ratings and hence not result in reduced equipment life.

2.0 Initial Conditions

2.1 The main generator is in service.

2.2 The generator voltage regulator is operating in automatic. If the regulator is operating in manual, extra operator attention may be required to maintain voltage schedule.

2.3 The control room operators are monitoring 500 KV Bus voltage in accordance with Attachment II. If the voltage is exhibiting instability or other evolutions are in progress which require the attention of the control room operator(s), enter computer alarm points at plus and minus 2 KV of the scheduled voltage. These alarm points will have to be updated each hour that the voltage schedule changes until the operators can resume their normal surveillance.

2.4 The actual 500 KV Bus voltage deviates by more than 2 KV from the scheduled voltage as noted on the Control Rm Operator's Instrument Surveillance Log, 2-PT-36.

3.0 Precautions and Limitations

3.1 Maintain H_2 pressure between 55 PSIG and 60 PSIG. Be prepared to increase generator pressure in order to attain full MVAR capability. This is especially important when operating the generator in the overexcited mode since at 55 PSIG, MVARs out are limited to 400 MVAR. Gas pressure must be increased to 60 PSIG before increasing MVARs out to ultimate limit of 430 MVAR.
NOTE: MVAR limitations specified in this procedure are for operation at 100% power. At lower power levels, the limits are higher (Reference Attachment I).

3.2 Monitor the generator core monitor closely during periods when the generator is being operated at high MVA loadings.

3.3 Limit generator amps to 24,713 at rated voltage of 22 KV.

3.4 The Summer continuous 90°C ratings for the 4 KV Cable between the Reserve Station Service Transformers and the Transfer Buses are as follows: 1684 Amperes for the cable on the secondary side of RSSTs A and C, 1624 Amperes for the cable on the secondary side of RSST B. During startup of one unit or within 1 hour of a one unit trip RSST loadings must be reduced below these ratings. With one unit in startup and one unit tripping or with two units tripping, RSST loadings must be reduced to 3000 Amperes within 30 minutes and to the specific cable ratings within 60 minutes.

3.5 Generator Output voltage shall be maintained between 20.9 KV and 23.1 KV.

3.6 The Unit 2 Station Service Buses 2B and 2C shall be operated between 4.0 KV and 4.4 KV. The 4.0 KV limit is based on limiting the stator temperature of the High Pressure Heater Drain Pump motors and most likely will be the limiting factor when operating a unit in the underexcited (MVARs in) mode. Station Service Bus 2A should normally be operated between 4.0 KV and 4.4 KV until operation between 3.6 KV and 4.0 KV has been demonstrated to be acceptable by further testing.

3.7 When operating the generator at a leading power factor (i.e. taking MVARs in), the MVAR limit shall be governed by the "Safe Operating Limit" on the generator capability curve unless directed otherwise by the System Operator. The Safe Operating Limit is a conservative limit for underexcited operation. Below this limit, there is the MEL (minimum excitation limiter) characteristic and the KLF (loss of field relay) characteristic. The MEL is a protective feature internal to the voltage regulator which will limit exciter field current to a predetermined level only when the regulator is operated in automatic. If the regulator is operated in manual (Base Adjuster control), the MEL unit is not functional, and operation below the Safe Operating Limit could result in a KLF operation and unit trip without prior alarm. The control room operator has no means to know from the control room that the MEL unit has operated other than the fact that the regulator is not responding to demand for lowering voltage. Operation of the MEL unit can be verified locally at the regulator panel. The KLF relay protects the unit against a loss of stability by tripping the exciter field breaker and the generator output breakers. The curves for MEL and KLF plotted on Attachment I are for a generator voltage of 22 KV. As the voltage varies from 22 KV, the curves shift upward for voltages less than 22 KV and downward for voltages greater than 22 KV.

3.8 When operating the generator at a lagging power factor (i.e. putting MVARs out), the MVAR limit shall be governed by the generator capability curve. It will be necessary to increase generator hydrogen pressure to 60 PSIG in order to reach the limit of 430 MVARs out.

3.9 Although not shown on the generator capability curves, the regulator has internal to it certain alarm and protective circuits which protect the generator when operating in the overexcited mode. These circuits do not perform their functions until the generator is operating outside the 60 PSIG capability curve, and therefore, their characteristics are not overlayed on Attachment I. These circuits operate as follows:

3.9.1. Forcing alarm picks up via K4 relay. Forcing alarm senses the DC current from the regulator power amplifiers to the exciter through an isolation transducer. This is only an alarm (Ann. window J-7, "Excitation Field Forcing") and has no tripping function.

3.9.2 The OXP-2 circuit senses the same signal as the forcing alarm. It operates in the following manner:

3.9.2.1 K1 picks up on an initial overexcitation and starts an inverse time delay dependent on the level of overexcitation. K1 also runs the base adjuster to a predetermined position by use of cam switches. <u>Note:</u> While K1 is timing, the regulator is still in auto control and voltage adjustments may be attempted by using Voltage Adjuster control switch. Since the base adjuster unit is automatically running to a preset position which upon reaching this position illuminates the white light above the Base Adjuster control switch, do not adjust the Base Adjuster control switch during this time.

3.9.2.2 After time delay for K1 has timed out, K2 picks up and trips the regulator from auto to base control and alarms Ann. window J-23, "Voltage Regulator Auto Trip". A contact from K2 also alarms Ann. window J-8, "Overexcitation".

3.9.2.3 After a fixed time delay in base control (approx. 3 sec.) if the overexcitation condition still exists, K3 picks up and trips the exciter field breaker (Mach. Trip).

3.9.2.4 If the unit did not trip, place the auto voltage regulator to OFF and adjust voltage with the Base Adjuster. Notify the System Operator that the voltage on the machine is being controlled manually.

3.10 The loss of regulator sensing voltage supplied by the voltage regulator potential transformers (possibly caused by a blown fuse) will automatically trip the regulator from auto to base control accompanied by the alarming of Ann. Window J-62, "Gen PT Blown Fuse" and Ann. window J-23, "Voltage Regulator Auto Trip".

3.11 The lights above the Base Adjuster control switch provide the following information:

Green light - Base Adjuster output is at lower limit.
Red light - Base Adjuster output is at upper limit.
Amber light - Base Adjuster output is at no load pre-position level.
Any time the exciter field breaker is opened or the breaker is racked to the Disconnect or Test position, the Base Adjuster is run back to this predetermined position.
White light - Base Adjuster output is at full load pre-position level.
When the K1 relay in the overexcitation protection circuit is energized, the Base Adjuster is run back to this predetermined position.

3.12 The lights above the Voltage Regulator control switch provide the following information:

Green light - Regulator output is at lower limit
Red light - Regulator output is at upper limit
Amber light - Regulator output at intermediate level as determined by adjustable cam switch setting.

3.13 The modes of operation of the voltage regulator are as follows:

3.13.1 OFF (Green light illuminated) - The only control of machine voltage is by the Base Adjuster control switch. There is no feedback of actual voltage via the regulator to the Trinistat Firing Circuit and the MEL unit is not operational. Before closing into the system, variations in turbine speed will change generator voltage.

3.13.2 TEST (Amber light illuminated) - The Base Adjuster control switch is the only means to control generator voltage. The output of the regulator logic drawer is not connected to the Trinistat Firing Circuit. The Voltage Adjuster control switch can be used to balance the regulator output meter since its operation will not change generator voltage.

3.13.3 ON (Red light illuminated) - The Voltage Adjuster control switch is used to adjust the desired setpoint for generator voltage. The feedback intelligence circuit will compare actual voltage with desired voltage and generate the appropriate buck or boost signal to the Trinistat Firing Circuit to vary exciter field current. The Base Adjuster control switch can be used to balance the regulator output meter since its operation will not change generator voltage.

3.14 The voltage regulator "balance volts" should be maintained at 0 using the appropriate control switch. When operating with the voltage regulator control switch in "ON", balancing should be done by using the Base Adjuster control switch. With the voltage regulator switch in "OFF", the switch must be placed in "TEST" before balancing using the Voltage Adjuster control switch. These operations will not cause generator voltage to change. They ensure that the voltage regulator output signal will not be overranged and will permit full regulator action under transient conditions.

3.15 There exists the possibility that the tertiary of the 500/230/36.5 KV autotransformers (rated for 97.7 MVA at a 55°C winding temperature rise) could become overloaded when the reactor banks on the 34.5 KV buses are in service. At 85 MVA loading, the System Operator will receive an alarm and will notify the Shift Supervisor of the condition. The station should remove one reactor bank at a time from service until the alarm clears. This action shall be taken within 30 minutes of the time the System Operator contacts the station.

3.16 There exists the possibility that the 230/36.5 KV transformer (rated for 112 MVA) could become overloaded when it is feeding a 34.5 KV Bus with reactor banks in service. At 95 MVA loading, the System Operator will receive an alarm and will notify the Shift Supervisor of the condition. The station should remove one reactor bank at a time from service until the alarm clears. This action shall be taken within 30 minutes of the time the System Operator contacts the station.

Initials

4.0 Procedure

4.1 Corrective actions to be taken in the event 500 KV voltage is sagging below scheduled voltage (Attachment II).

_______ 4.1.1 Initial conditions are noted and satisfied.

_______ 4.1.2 Precautions and Limitations are noted.

_______ 4.1.3 Verify generator core monitor is energized.

NOTE: The following steps assume the regulator is in automatic. If the regulator is operating in manual, the Base Adjuster control switch must be used to raise generator voltage.

_______ 4.1.4 Use Voltage Adjuster control switch in the raise direction to attempt to increase 500 KV voltage to scheduled value. This will tend to increase the outward flow of VARS from the generator.

CAUTION: Reference Attachment I and Precaution and Limitation 3.1.

_______ 4.1.5 If the 500 KV Bus voltage falls more than 4 KV below scheduled, start taking hourly readings of the 500 KV Bus voltage and record data on Attachment III. Continue to adjust the Voltage Adjuster control switch in the raise direction as required in an attempt to meet the scheduled voltage.

_______ 4.1.6 If the 500 KV Bus voltage falls to 515 KV, verify that the 34.5 KV reactor banks are out of service. If they are in service, notify the System Operator before removing them from service.

_______ 4.1.7 Review Precautions and Limitations 3.5, 3.6, 3.8, and 3.9. At any time these limitations prevent increasing MVAR output of generator, notify the System Operator and document the reason on Attachment III.

_______ 4.1.8 If 500 KV Bus voltage falls to 514 KV, increase generator hydrogen pressure to 60 PSIG if not already done.

_______ 4.1.9 If the 500 KV Bus voltage falls to 512 KV, make sure the generator is being operated at the limit of 430 MVARs out unless other restrictions prohibit such operation.

NOTE: At 510 KV on the Surry 500 KV Bus, the System Operator will receive a computer data acquisition alarm. He will refer to Page 11.01(2) of the System Operators' Procedures Manual and initiate system level actions as specified in his procedure.

________ 4.1.10 If voltage continues to drop below 511 KV and all actions above have been taken, immediately notify the System Operator.

________ 4.1.11 Continue to log the information as started in Step 4.1.5 on Attachment III on an hourly basis until the 500 KV Bus voltage returns to scheduled voltage ±2 KV.

Completed By: ________________

Date: ________________

Initials

4.2 Corrective actions to be taken in the event 500 KV voltage is rising above scheduled voltage (Attachment II).

_______ 4.2.1 Initial conditions are noted and satisfied.

_______ 4.2.2 Precautions and Limitations are noted.

_______ 4.2.3 Verify generator core monitor is energized.

NOTE: The following steps assume the regulator is in automatic. If the regulator is operating in manual, the Base Adjuster control switch must be used to lower generator voltage.

_______ 4.2.4 Use Voltage Adjuster control switch in the lower direction to attempt to decrease 500 KV voltage to scheduled value. This will tend to increase the inward flow of MVARs from the system.

CAUTION: Reference Attachment I. Operation of the regulator in Base Adjuster control beyond the Safe Operating Limit requires prior System Operator approval (See Step 4.2.10).

_______ 4.2.5 If the 500 KV Bus voltage increases to more than 4 KV above scheduled, start taking hourly readings of 500 KV Bus voltage and record data on Attachment III. Continue to adjust the Voltage Adjuster control switch in the lower direction as required in an attempt to meet the scheduled voltage.

_______ 4.2.6 If the 500 KV Bus voltage increases to 520 KV, verify that the 34.5 KV reactor banks are in service. If they are out of service, notify the System Operator before placing them in service.

NOTE: Refer to Precaution and Limitation 3.15 and 3.16.

_______ 4.2.7 Review Precautions and Limitations 3.5, 3.6, and 3.7. At any time these limitations (especially the 4 KV limit on Station Service Buses) prevent increasing MVAR intake of the generator, notify the System Operator and document the reason on Attachment III. See Step 4.2.13 for further action.

_______ 4.2.8 If the 500 KV Bus voltage increases to 525 KV, increase generator hydrogen pressure up to 60 PSIG (Max.) as required. Note that higher pressures will not be required unless the generator is to be operated beyond the Safe Operating Limit (Reference Attachment I) or generator temperatures dictate the higher pressure.

_______ 4.2.9 If the 500 KV Bus voltage increases to 528 KV, make sure the generator is being operated at the Safe Operating Limit of 210 MVARs in provided the regulator is operating in automatic.

If generator output voltage drops sufficiently, the MEL unit may operate before reaching 210 MVAR in as explained in Precaution and Limitation 3.7.

NOTE: At 530 KV on the Surry 500 KV Bus, the System Operator will receive a computer data acquisition alarm. At this point, he will refer to Page 11.01(5) of the System Operators' Procedures Manual and initiate system level actions as specified in his procedure.

_______ 4.2.10 If the 500 KV Bus voltage increases above 528 KV, notify the System Operator that the generator is operating at the Safe Operating Limit of 210 MVARs in or is limited by the MEL unit as the case may be. If the regulator is operating in automatic and the MEL has not already limited MVARs in, the station will be authorized to operate beyond the Safe Operating Limit with concurrence of the Shift Supervisor. If the regulator is operating in manual (ie. Base Adjuster control), the System Operator will be responsible for authorizing operation beyond the Safe Operating Limit. Note authorized higher limit: _______________.

CAUTION: If regulator is being operated in manual, the MEL unit is not functional (Reference Precaution and Limitation 3.7).

_______ 4.2.11 When operating beyond the Safe Operating limit, increase the MVAR loading in 5 MVAR increments being careful to zero the "Regulator Balance Volts" meter after each increase using the Base Adjuster control switch. Use Voltage Adjuster if in manual regulator operation . If during this process of increasing the MVARs in, the MEL unit operates, the regulator will not respond to a demand signal for lowering voltage, and the generator will not take in any additional MVARs. Confirm that the MEL unit has operated by checking at the local regulator panel.

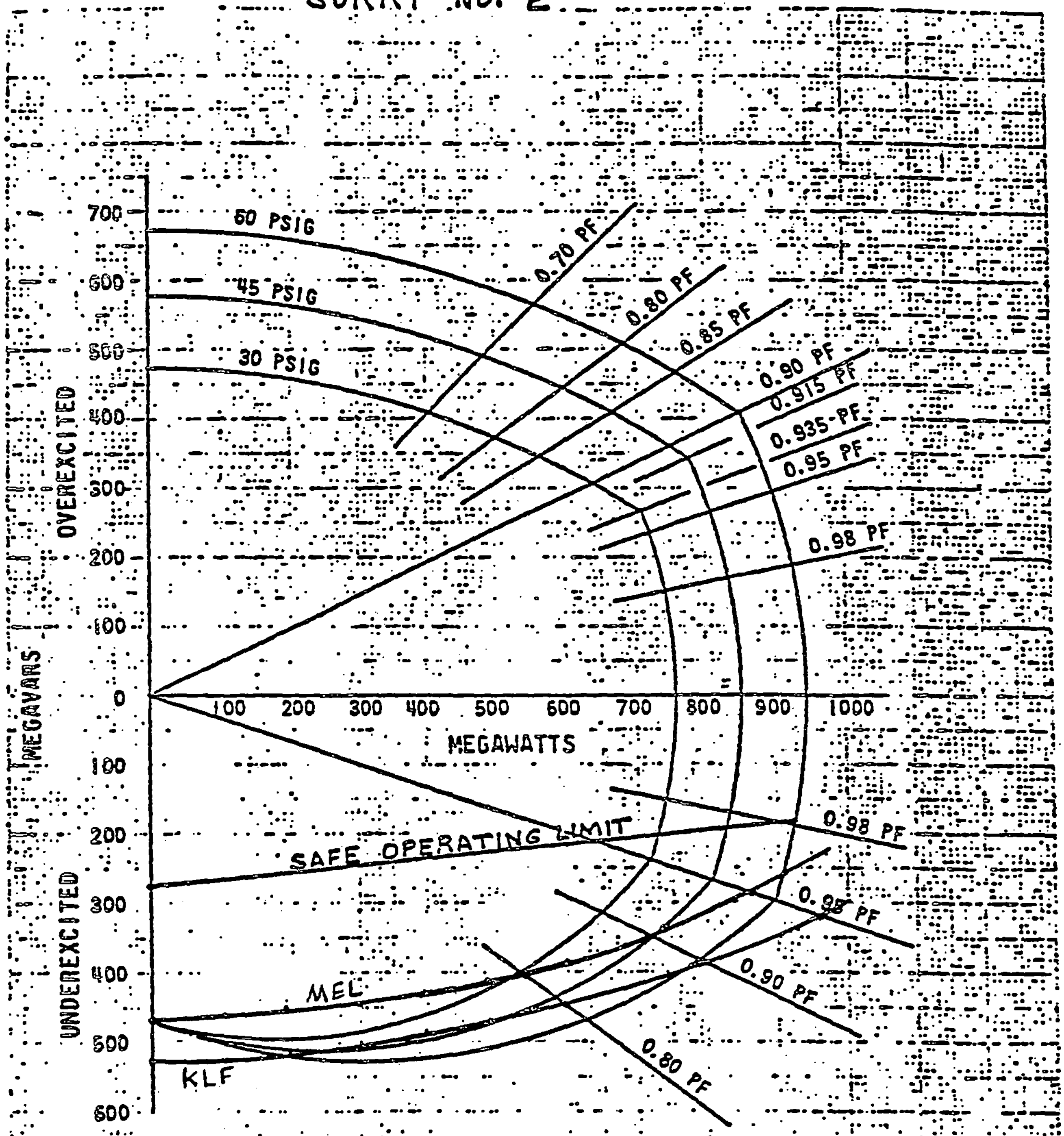
_______ 4.2.12 Notify the System Operator that the MVAR loading on the generator is limited by the regulator MEL unit. Record the MVAR limit on Attachment III.

_______ 4.2.13 Continue logging the information as started in Step 4.2.5 on Attachment III on an hourly basis until the 500 KV Bus voltage returns to scheduled voltage ±2 KV.

Completed By: ____________________

Date: ____________________

SURRY NO. 2



HYDROGEN INNER-COOLED TURBINE GENERATOR

CALCULATED CAPABILITY CURVES

941,700 KVA, 0.90 PF, 0.58 SCR, 60 PSIG, 3 PH

60 CYCLES, 1800 RPM

$I_{F1} = \frac{941,700}{(\sqrt{3})(22)} = 24,713$

APPROVED [signature]

CHAIRMAN: SURRY POWER STATION NUCLEAR SAFETY AND OPERATING COMMITTEE

DATE APR 1 0 1981

Curve 620411 Capability Curve FIG. 1

VIRGINIA ELECTRIC AND POWER COMPANY
VOLTAGE SCHEDULE

STATION Surry VOLTAGE 500 kV

Monday - Friday			Saturday - Sunday - Holiday		
Time	Schedule Voltage (KV)	On/Off Peak	Scheduled Voltage (KV)	On/Off Peak	Time
1:00 A	515	off	515	off	1:00 A
2:00 A	515	off	515	off	2:00 A
3:00 A	515	off	515	off	3:00 A
4:00 A	515	off	515	off	4:00 A
5:00 A	515	off	515	off	5:00 A
6:00 A	515	off	515	off	6:00 A
7:00 A	520	on	515	off	7:00 A
8:00 A	520	on	515	off	8:00 A
9:00 A	520	on	515	off	9:00 A
10:00 A	520	on	515	off	10:00 A
11:00 A	520	on	515	off	11:00 A
12:00 N	520	on	515	off	12:00 N
1:00 P	520	on	515	off	1:00 P
2:00 P	520	on	515	off	2:00 P
3:00 P	520	on	515	off	3:00 P
4:00 P	520	on	515	off	4:00 P
5:00 P	520	on	515	off	5:00 P
6:00 P	520	on	515	off	6:00 P
7:00 P	520	on	515	off	7:00 P
8:00 P	520	on	515	off	8:00 P
9:00 P	520	on	515	off	9:00 P
10:00 P	515	off	515	off	10:00 P
11:00 P	515	off	515	off	11:00 P
12:00 M	515	off	515	off	12:00 M

Authorized by: R. W. Ellis Manager-Power Supply Dept.
Date Effective: 6/7/82 Supersedes Schedule Dated 8-20-80

Notes:
1) All voltage changes should be made in the 10 minute period prior to the hour.
2) Only the following days will be considered as holidays: New Years Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day
3) In addition to days specified in (2) the system operator may designate holiday schedule for any other appropriate day.

SURRY

DEVIATION LOG
500KV Voltage Schedule

Purpose: Record Data as required by 2-OP-26.5 whenever 500 KV Bus Voltage deviates by more than 4 KV from scheduled voltage.

UNIT	TIME	500KV		GEN		EXCITER		STATION SERVICE BUS(4K.V-4.4K.V)						REMARKS IF OTHER THAN STATION SERVICE VOLTAGE LIMITS	
		ACTUAL	SCHEDULE	VOLTS	VARS	VOLTS	AMPS	A VOLTS	AMPS	B VOLTS	AMPS	C VOLTS	AMPS		DATE

ADDITIONAL ADMINISTRATIVE LIMITS

NOTE: Until directed otherwise, at the end of each month, forward one copy of each completed Deviation Log to Director Power Supply Technical Services (4th Floor, OJRP). Questions related to the use of log should be directed to Phil Powell on Ext. 4343.

ATTACHMENT II

This Attachment provides a draft of our proposed Technical Specifications as requested in the following NRC Question:

NRC Question 5: "Submit draft proposed Technical Specifications changes to address limiting conditions for operation, testing, calibration, and surveillance requirements for the proposed undervoltage protection schemes. Also, a test is required to be included in the Technical Specifications to demonstrate the operability of the automatic bypassing and auto-reinstatement of the undervoltage relays when the diesel generators are supplying the Class 1E buses (see NRC letter dated June 3, 1977)."

TABLE 3.7-2

ENGINEERED SAFEGUARDS ACTION

INSTRUMENT OPERATING CONDITIONS

		1	2	3	4
	FUNCTIONAL UNIT	MIN. OPERABLE CHANNELS	DEGREE OF REDUNDANCY	PERMISSIBLE BYPASS CONDITIONS	OPERATOR ACTION IF CONDITIONS OF COLUMN 1 OR 2 EXCEPT AS CONDITIONED BY COLUMN 3 CANNOT BE MET
d.	Station Blackout Start Motor Driven Pump	2	0		Restore inoperable channel within 48 hours or be in hot shutdown within next 6 hours and in cold shutdown within the following 30 hours.
e.	Trip of Main Feedwater Pumps Start Motor Pumps	1/Pump	1/Pump		Restore inoperable channel within 48 hours or be in hot shutdown within next 6 hours and in cold shutdown within the following 30 hours.
4.	LOSS OF POWER				
a.	4.16 KV Emergency Bus Undervoltage (Loss of Voltage)	2/Bus	1/Bus		
b.	4.16 KV Emergency Bus Undervoltage (Grid Degraded Voltage)	2/Bus	1/Bus		

TABLE 3.7-4

ENGINEERED SAFETY FEATURE SYSTEM INITIATION LIMITS INSTRUMENT SETTING

NO.	FUNCTIONAL UNIT	CHANNEL ACTION	SETTING LIMIT
6.	AUXILIARY FEEDWATER		
	a. Steam Generator Water Level Low-Low	Aux. Feedwater Initiation S/G Blowdown Isolation	≧5% narrow range
	b. RCP Undervoltage	Aux. Feedwater Initiation	≧70% nominal
	c. Safety Injection	Aux. Feedwater Initiation	All S.I. setpoints
	d. Station Blackout	Aux. Feedwater Initiation	≧46.7% nominal
	e. Main Feedwater Pump Trip	Aux. Feedwater Initiation	N.A.
7.	LOSS OF POWER		
	a. 4.16 KV Emergency Bus Undervoltage (Loss of Voltage)	Emergency Bus Seperation and Diesel start	75^{+1}_{-1}% volts with a 2+5,-0.1 second time delay
	b. 4.16 KV Emergency Bus Undervoltage (Degraded Voltage)	Emergency Bus Seperation and Diesel start	$90^{+1.0}_{-1.0}$% volts with a 60±3.0 second time delay (Non CLS, Non SI) 7±.35 second time delay (CLS or SI Conditions)

TABLE 4.1-1 (Continued)

CHANNEL DESCRIPTION	CHECK	CALIBRATE	TEST	REMARKS
35. LOSS OF POWER				
a. 4.16 KV Emergency Bus undervoltage (Loss of voltage)	N.A.	R	M	
b. 4.16 KV Emergency Bus undervoltage (Degraded voltage)	N.A.	R	M	

ATTACHMENT III

This Attachment addresses the following NRC Questions:

NRC Question 6: "Are the following viable source connections?

(a) A single 500/230/36.5 KV autotransformer supplying both 34.5 KV buses 5 and 6 (i.e., breaker LT22 open and LT12 closed (or vice versa), T562 closed and both L402-5 and L402-6 open).

(b) The 230/36.5 KV transformer supplying both 34.5 buses 5 and 6 (i.e., breakers LT12 and LT22 open, T562 closed and L402-5 closed and L402-6 open (or vice versa)).

If these are not viable connections, are there interlocks to prevent these breaker alignments?"

NRC Question 7 "Are there interlocks to prevent closure of both the 34.5 KV low side breakers on the 230/36.5 KV transformer?"

As discussed in our June 11, 1982 letter to you, Serial No. 317, the three arrangements discussed in Questions 6 and 7 are physically possible arrangements. There are no electrical interlocks which prevent these arrangements. An arrangement with the 230/36.5KV transformer supplying both 34.5KV buses at the same time, through L402-5 and L402-6 with T562 open, is the most probable arrangement, since it may occur automatically. The arrangements discussed in Question 6 require manual closure of the disconnect switches on both sides of T562 prior to implementation of the arrangements. As we originally stated in our May 20, 1982 telephone conference with Messrs. D. Neighbors, R. Trevatte and J. Sealan, we believe the probability of two transformer failures combined with an SI or CLS is extremely small. We, therefore, did not analyze these scenarios. The following scenarios do include these arrangements and are provided in response to your request.

Case I, Job Numbers 1459 and 2734, analyzes the 230/36.5KV transformer feeding both 34.5KV buses, regardless of which breaker alignment is in use. The scenario studied is a Unit 2 CLS assuming Unit 2 station service loads transfer to the Reserve Station Service Transformers (RSST's) at the instant the CLS occurs. Unit 1 is assumed to trip and transfer its station service loads to the RSST's 60 seconds after the Unit 2 CLS.

In Case I, the 4KV motors have adequate voltage to accelerate at T=0 seconds. The minimum required 480V load center voltage at bus 2H is 70.9% to start the Containment Spray Pump and 72.0% to start the Low Head Safety Injection Pump. At 480V bus 2J the voltage requirements are 73.3% and 73.5% to start the Containment Spray and Low Head Safety Injection Pumps, respectively. At T=0 seconds, the 2H and 2J 480V bus voltages are 70.2% and 70.5%, respectively. Since two Charging Pumps were modeled as starting when one would normally be running, these voltages are lower than actually expected for this scenario. With acceleration of the 4KV Charging Pumps and an instantaneous signal to the RSST's load tap changer (LTC) to begin correction, the voltage profile will improve to enable the starting of the 480V motors. MOV's rated at 368V starting will receive adequate starting voltage in sufficient time to ensure their overload heaters will not operate. At T=7 seconds, the LTC taps will be advanced by another step and spurious separation will not occur (the degraded voltage setpoint during accident conditions is 90% voltage at 7 seconds). Analysis at T=59 seconds is equivalent to a steady state condition for single unit loading to the RSST's. The voltages at this time are acceptable. Analysis of the steady state voltages at T=infinity, which represents the effects of two unit loading on the RSST's, indicates unacceptably low voltages on 480V buses 1H1, 1J1, 2H, 2H1, 2J and 2J1.

Case II, Job Numbers 1609 and 3589, analyzes a 500/230/36.5KV autotransformer feeding both 34.5KV buses, irregardless of which breaker alignment is in use. The scenario analyzed is the same as in Case I. The resultant voltages are approximately 1% - 2.5% lower than those in Case I during motor starting and 2.5% - 3% lower at steady state. These are unacceptable results.

With reference to Technical Specification Section 3.16, each 500/230/36.5KV autotransformer and the 230/36.5KV transformer is considered to be a primary source which can supply offsite power to a 34.5KV bus. The intent of item B.2 is to maintain separate offsite supplies to each 34.5KV bus. With only one of the above mentioned transformers supplying both 34.5KV buses, both units may be operated for seven days, provided the dependable alternate source can be operable within eight hours. This restriction sufficiently controls operation with a single transformer supplying both 34.5KV buses. In view of the low probability of these events, modifications are not required to prevent this operating arrangement.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 23/24
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
		13930.09-9		

JOB 2734 (6/14/82)
& JOB 1459 (6/15/82)

CASE I

SUMMARY OF RESULTS

UNIT 2 CLS, UNIT 1 TRIP 60 SECONDS LATER
(230/36.5KV TRANSFORMER FEEDS BOTH 34.5KV BUSES)
(150 HP FILTER EXHAUST FANS STARTING ON 480V BUSES 2H & 2J)

1) t=0 ; ALL MOTORS STARTING (FIXED TAPS)

	1H	1J	2H	2J
4160V	.846	.868	.846	.846
480V	.794	.818	.702	.705
480V-1	.818	.841	.744	.754

2) t= 5 SECONDS ; LARGE MOTORS ACCLD ; MOVS STARTING (TAPS ADV 2 STEPS)

	1H	1J	2H	2J
4160V	.903	.907	.903	.903
480V	.858	.863	.882	.887
480V-1	.880	.884	.852	.865

3) t= 59 SECONDS ; PRIOR TO UNIT 1 TRIP & TRANSFER (LTC SETTLES)

	1H	1J	2H	2J
4160V	1.025	1.027	1.025	1.025
480V	.993	.995	.979	.982
480V-1	1.011	1.013	1.014	1.023

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 24/24
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO. 13930.09-9	OPTIONAL TASK CODE	

4) t = 60 SECONDS ; UNIT 1 TRANSFERS TO RSST (FIXED TAP)

	1H	1J	2H	2J
4160V	.893	.886	.882	.893
480V	.894	.888	.816	.833
480V-1	.874	.859	.860	.883

5) t = ∞ ; STEADY STATE (LTC SETTLES)

	1H	1J	2H	2J
4160V	.893	.894	.890	.893
480V	.894	.897	.825	.833
480V-1	.874	.867	.869	.883

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 12/24
		13930.09-9		

JOB 3589 (6/9/82)
& JOB 1609 (6/10/82)

CASE II

SUMMARY OF RESULTS

UNIT 2 CLS, UNIT 1 TRIP 60 SECONDS LATER
(SINGLE AUTOTRANSFORMER FEEDS BOTH 34.5kV BUSES)
(150HP FILTER EXHAUST FANS STARTING ON 480V BUSES 2H1 & 2J1)

1) t=0 ; ALL MOTORS STARTING (FIXED TAP)

	1H	1J	2H	2J
4160V	.829	.858	.835	.828
480V	.774	.807	.692	.690
480V-1	.799	.831	.733	.738

2) t=5 SECONDS ; LARGE MOTORS ACCLD ; MOVS STARTING (TAPS ADV 2 STEPS)

	1H	1J	2H	2J
4160V	.883	.894	.890	.883
480V	.836	.848	.868	.865
480V-1	.858	.870	.838	.845

3) t=59 SECONDS ; PRIOR TO UNIT 1 TRIP & TRANSFER (LTC SETTLED)

	1H	1J	2H	2J
4160V	.962	.975	.968	.962
480V	.924	.939	.915	.911
480V-1	.944	.958	.953	.956

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 13/24
		13930.09-9		

4) t = 60 SECONDS; UNIT 1 TRANSFERS TO RSST (FIXED TAP)

	1H	1J	2H	2J
4160V	.869	.869	.865	.868
480V	.868	.871	.796	.805
480V-1	.847	.840	.841	.857

5) t = ∞ ; STEADY STATE (LTC SETTLED)

	1H	1J	2H	2J
4160V	.869	.869	.865	.868
480V	.868	.871	.796	.805
480V-1	.847	.840	.842	.857